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Increasing Employability and Livelihood of Entirely Paralyzed People using ACAT(Assistive Context Aware Toolkit)

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Abstract

Assistive Context-Aware Toolkit (ACAT) is an Intel Labs proprietary open source softwarewhich has enabled people like Stephen Hawking with motor neuron diseases and other disabilities to have full access to the capabilities and applications of their computers. ACAT enables entirely paralyzed individuals to easily communicate with others through keyboard simulation, word prediction and speech synthesis. This paper examines the ease and efficacy with which the software can be deployed and made suitable for users. It facilitates the use of technology to those who were otherwise incapable of accessing it, therefore making them more employable. This provides them the platform and opportunity to nature their skills and grow into potential drivers of growth by becoming successful entrepreneurs and innovators.

What is ACAT

Assistive Context-Aware Toolkit (ACAT) is an open source platform developed at Intel Labs to enable people with motor neuron diseases and other disabilities to have full access to the capabilities and applications of their computers through very constrained interfaces suitable for their condition. More specifically, ACAT enables users to easily communicate with others through keyboard simulation, word prediction and speech synthesis. Users can perform a range of tasks such as editing, managing documents, navigating the Web and accessing emails.

ACAT was originally developed by researchers at Intel Labs for Professor Stephen Hawking, through a very iterative design process over the course of three years. Professor Hawking was

instrumental to the design process and was a key contributor to the project design and validation. After Intel deployed the system to Professor Hawking, we turned our attention to the larger community and continued to make ACAT more configurable to support a larger set of users with different conditions.

Our hope is that, by open sourcing this configurable platform, developers will continue to expand on this system by adding new user interfaces, new sensing modalities, word prediction and many other features. ACAT is designed to run on Microsoft Windows* machines and can interface to different sensor inputs such as infrared switches, camera, push buttons, and more.

ACAT is available in English, French, Spanish and Portuguese. With the help of the user/developer community, Intel is working on extending it to other languages.

ACAT is useful for Microsoft Windows developers who are interested in developing assistive technologies to people with ALS or similar disabilities. Also for researchers who are working on new user interfaces, new sensing modalities or word prediction and wanting to explore these innovations in the this community

Stephen Hawking and Intel

The software used to help Stephen Hawking communicate with the world has been made available by Intel for free online in the hopes it can help other people with similar disabilities.

Hawking, 73, who has a motor neuron disease and is almost entirely paralyzed, relies on the technology to speak. His speech system got an upgrade from Intel last year, allowing him to type faster, browse the Internet much easier and seamlessly switch between tasks.

The hope is the code for that software, called **Assistive Context-Aware Toolkit (ACAT)**, will be leveraged by developers who are running Microsoft Windows 7 or higher to create new interfaces that could help people with ALS, Lou Gehrig's disease, spinal cord injuries and other disabilities communicate with the world.

In Hawking's case, his cheek sensor syncs with a switch on his glasses, allowing him to choose characters he wishes to type, which can then be processed by his speech synthesizer and spoken out loud from his laptop.

It also allows the cosmologist to use various computer programs and navigate the Internet. Intel said last year it was able to increase the efficiency of Hawking's system by integrating predictive text technology. The software knows Hawking's communication patterns, meaning he has to type less than 20 percent of all characters to convey what he wants to say.By making the program open source, Intel said it hopes developers will be able to experiment and expand on the system by creating new interfaces and ways for sensors to connect with the system.

Motivation On Selecting The Topic

ACAT is a technology that can help millions of people if it is implemented at a large scale.It gives a kind of new life to a paralyzed person as he can talk and respond to actions which he cannot do earlier.

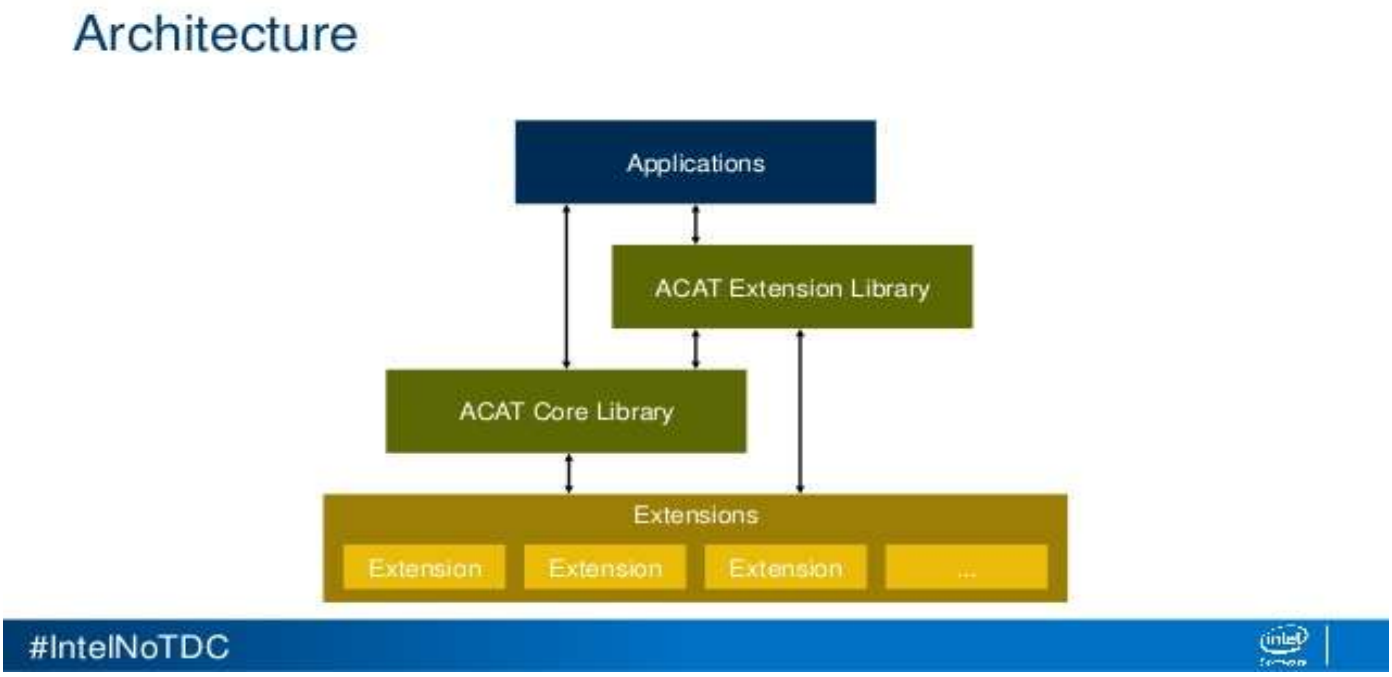
If this technology is made available to a greater population with disabilities limiting them from communicating or using the computer or the internet, it could greatly change the scenario. We are lucky to have this technology in an era of personal computers where it can be used properly.

Intel has Open-Sourced the ACAT software so that users can try the software and they can twerk the software according to their needs or provide necessary changes to the software so that more and more people can benefit from the software.

It is highly customizable according to the user's needs so that every paralyzed patient can take full advantage of this technology, by modifying the software according to their disability

Technical Details

1. ACAT(Assistive Context-Aware Toolkit) runs only onWindows 7 or higher
2. Written on Visual Studio 2012 or higher
3. Coded entirely in C#
4. Uses Microsoft .NET Framework 4.5
5. Microsoft Office Interop Assemblies are used to interact with Office apps
6. Bundled with Visual Studio Professional/Premium/Ultimate
7. Optional Visual Studio Add-ons
8. StyleCop (free) to enforce .NET coding standards
9. CodeMaid (free) to cleanup/reorganize the code
10. ReSharper (paid) to optimize the code



ACAT Architecture

The ACAT model consists of two major libraries:-

- ACAT Core Library
- ACAT Extensions Library

There is a user side interface called the **Applications**, through which the user interacts with the system and the two libraries.

Applications

ACAT Core Library

The ACAT Core library is a single DLL that provides all the core services. Figure shows the components that make up the Core library.

Panel Management

All the scanners, dialogs and menus are also extensions. The word Panel is used to denote a scanner, a dialog or a menu. ACAT uses the Window stacking model to display panels. The look and feel of panels can be configured through Panel config files and the preferred panels to display can also be configured.. The Panel Manager in this component is responsible for enumerating panels, handling requests to display them, maintaining the stack of active panels, activating and deactivating them.

Animation Manager

The Animation Manager in this component is responsible for loading animation files which contain the scanning sequence for scanners, executing the scanning process and handling transitions between scanning sequences.

Widget Management

A widget is a wrapper class around the controls in a scanner. It contains additional attributes controlling the appearance and behavior such as fonts, colors and text. The Widget Manager in this component reads the attributes for the active scanner, instantiates the widget objects for the elements in the scanner and also controls the appearance of the scanner elements during scanning.

Word Predictor Management

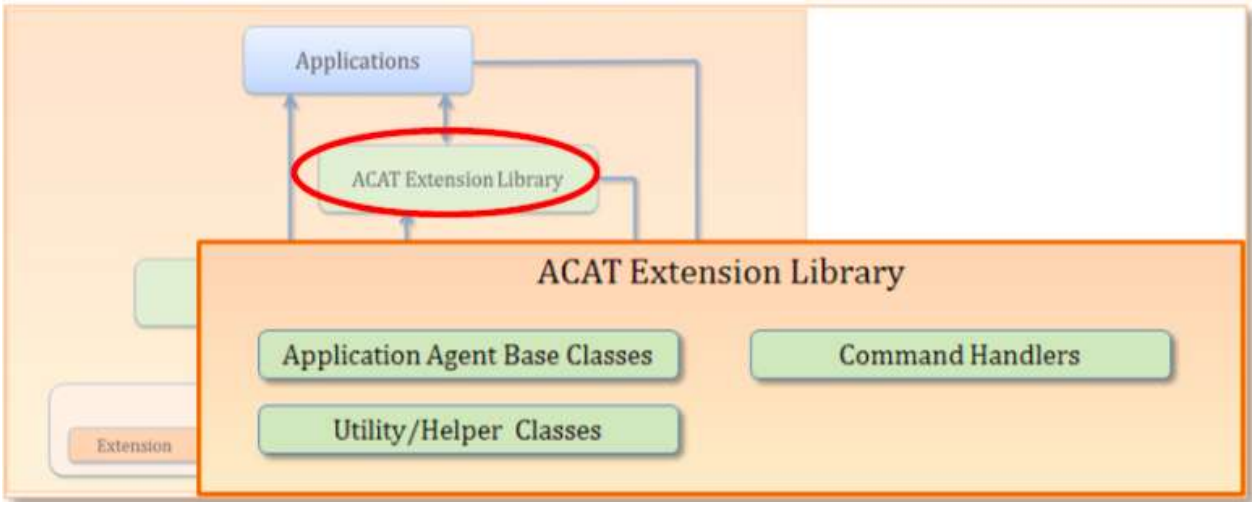
Next-word prediction during text entry is one of the key features of ACAT. The Word Prediction Manager in this component enumerates installed Word prediction extensions, and activates and configures the preferred Word prediction extension.

Theme Management

ACAT supports color schemes for the scanners, dialogs and menus. The Theme Manager in this component enumerates and manages installed themes.

ACAT Extension Library

The ACAT Extension Library has helped classes and base classes for the development of Panels and Agents.Just like the core library, the extension library comprises of sections of various independent extensions ;all working in synchronization with the system.



Application Agent Base Classes

The base classes for Application agents do most of the heavy lifting required to support applications such as Notepad, Microsoft Word, and Internet Explorer, etc. This makes it easier to derive and extend the functionality provided by the base classes.

Command Handlers

ACAT supports a host of ‘commands’, strings that represent action verbs Examples of commands are CmdTalkWindowToggle to toggle the visibility of the Talk window, CmdMainMenu to display the Main menu. These commands can be attached to events such as actuating an element on a scanner or to input switches. The Extension library has default handlers for various commands. See Chapter 14 for details on Command Handlers.

Utility Classes

The Extension library has a number of utility/helper classes to display dialogs, load/store ACAT settings ,etc.

Actuators

Actuators are input trigger mechanism which are translated into actions. They are used to drive the UI.Each Actuators is an ACAT Extension which is composed of Switches. ACAT actions are mapped to each switch which are associated with an event.Actuators interface with the underlying hardware.
-E.g. Left and right mouse buttons are two switches on a mouse.
For gesture input, each gesture can be treated as a Switch

ACAT has helper classes to interface with

1. -USB HID Devices

2. -TCP/IP Servers/Clients

Support included for facial gesture recognition, proximity sensor, accelerometer ring 32.

The following switch mechanisms are supported by ACAT:

- **Keyboard:** The function key F12 is the default key to trigger ACAT. Every time the user hits F12, the scanner will respond by executing the action associated with the highlighted element. You can change the default key through the ACAT **Config** utility. Refer to the ACAT User Guide or to the ACAT FAQ for details.

- **ACAT Vision:** ACAT vision application uses a webcam to detect facial gestures which are then translated into trigger events.

- **Off-the-shelf switches**: ACAT supports a number of off-the-shelf switches which plug into the USB interface of your computer. These switches can be configured to send specific keystrokes whenever the switch is activated. To work with ACAT, the switches should be configured to send a F12 key (or whichever is the default key) press event every time the switch is activated.

Note: Out of the box, ACAT supports keyboard and ACAT vision as input switch mechanisms. The mouse can also be used to activate the UI by pointing and clicking. New hardware or software switches can be integrated with ACAT through Actuator extensions. See section 6.5 for step-by-step instructions to develop Actuator extensions.

Creating an Actuator Extension

- Create a new "Class Library" project and add references to "ACATCore.dll" and "ACATExtension.dll"
- Extend the classes "ActuatorBase" and "ActuatorSwitchBase" to interact with ACAT
- Implement the abstract methods and the use the callbacks (Init, Resume, Pause, Dispose) to run the code of your extension (threads, config, etc)
- Call the methods OnSwitchActivated (Hold/Press), OnSwitchDeactivated (Release) or OnSwitchTriggered(Click) to finalize the interaction from the actuator
- Deploy your DLL to the extension folder and update the configuration files

All Actuator extension DLL's must be installed under the Actuators root folder which is [INSTALLDIR]\Extensions\[EXTENSION_DIR]\Actuators. Under this, each actuator DLL should reside in its own sub-folder. For instance, the ACAT vision actuator is installed under C:\Intel\ACAT\Extensions\Default\Actuators\VisionActuator. During initialization, the Actuator Manager walks recursively through the Actuators root folder, loads all the DLL's in there and creates instances of classes that derive from ActuatorBase.

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Future scope :Intel RealSense

Intel RealSense Technology,is a suite of depth and tracking technologies designed to give machines and devices depth perceptions capabilities that will enable them to "see" and understand the world. There are many uses for these computer vision capabilities including autonomous drones, robots, AR/VR, smart home devices amongst many others broad market products. RealSense technology is made of Vision Processors, Depth and Tracking Modules, and Depth Cameras, supported by an open source, cross-platform SDK called librealsense that simplifies supporting cameras for third party software developers, system integrators, ODMs and OEMs.

As of January 2018, new Intel RealSense D400 Product Family was launched with the Intel RealSense Vision Processor D4, Intel RealSense Depth Module D400 Series, and 2 ready to use depth cameras: Intel RealSense Depth Cameras D435 and D415.

Previous generations of Intel RealSense depth cameras (F200, R200 and SR300) were implemented in multiple laptop and tablet computers by Asus, HP, Dell, Lenovo, and Acer[].Additionally, Razer and Creative offered consumer ready standalone webcams with the Intel RealSense camera built into the design. Razer Stargazer and the Creative BlasterX Senz3D.innovations such as Intel RealSense technology are bringing new sensory capabilities to computers and digital devices.

Conclusion

The paper uses a simple model to explain the welfare implications of ACAT. The application encourages differently abled people, who would otherwise be neglected in this technology driven world to go ahead and become adept at it. Just like ACAT helped Stephen Hawking to continue exploring outer space using the most sophisticated technology despite the complete motor neuron failure he sustained at a very young age, it can help others like him to become of drivers of growth and technology.

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